

WELCH (W^m H.)

HIGHER MEDICAL EDUCATION AND THE NEED
OF ITS ENDOWMENT.

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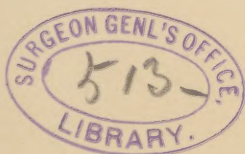
PROFESSOR OF PATHOLOGY IN THE JOHNS HOPKINS UNIVERSITY.

THE invitation which I received from the Medical Faculty of the Western Reserve University, to deliver an address upon this occasion, carried with it the suggestion that I should speak of higher medical education, and of some of the advantages of liberal endowment of medical education. My choice of subject is in accordance with this suggestion, as well as with my own inclination.

The time has come when the needs of medical education should be brought forcibly before the general public in this country. Medicine can no longer be taught with the simple appliances of former times. The proper teaching of medicine now requires hospitals, many laboratories with an expensive equipment and a large force of teachers, some of whom must be paid enough to enable them to devote their whole time to teaching and investigating. These things require large endowments of money, and cannot be adequately secured simply from the fees of students. If the public desires good physicians it must help to make them.

In this country, for the most part, we cannot look to the State for endowment of medical education, but we

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must appeal to private beneficence. A few public-spirited and generous men and women have already given practical proof of their appreciation of these facts. With more general and fuller realization of the needs and present condition of medical education, and of the results that can be secured by its liberal endowment, there is every reason to believe that these benefactions will be largely and rapidly increased, and that thereby the condition of medical education in this country shall cease to be a reproach to us. During the last few years our methods and standards of medical teaching have shown remarkable improvement.

What I shall have to say concerning higher medical education will relate to what may be done where there are adequate pecuniary resources outside of the fees of students, rather than to what may be practicable now in this place or generally in this country. The hampered conditions prevailing in most medical schools in this country do not permit the complete realization of the methods and standards of education of which I shall speak. One of the principal aims of this address, however, is to indicate the importance of securing endowments, in order to improve the character of medical education. I do not intend, however, to draw an ideal picture, but only one that is realized in many foreign countries, and which is in measurable distance of accomplishment in several medical schools of this country.

What preparation should a student bring to the study of medicine? It is highly desirable, in my judgment, that he should be liberally educated; that is, he should possess a degree in arts or in science which shall be an index of that knowledge and culture which, apart from any immediate bearing upon professional studies, are recognized as entitling their possessor to be ranked among liberally educated men. Scientific studies have acquired the right to rank with classic studies in affording this liberal culture; but the humanities should have a fair share of attention at this period of education.

The question has been discussed whether or not during the period of collegiate education the student who intends to study medicine should be required to pursue any special subjects, and especially such as bear a direct relation to his future professional studies. The answer to this question seems to me to depend upon the character of collegiate training on the one hand, and of medical training on the other hand. The primary purpose of collegiate education is to furnish a broad basis of mental discipline and liberal culture, independently of direct relation to professional work. Where, as in the old-fashioned colleges in this country, and in the gymnasia and lycées of Germany and France, the student enters college at the age of fifteen or sixteen, and is graduated at nineteen or twenty, it is not necessary or even desirable that the undergraduate student should specialize his work with reference to his future profession. Under these circumstances, which obtain in most foreign universities, at least the first year of medical study is devoted mainly to physics, chemistry and zoölogy, including comparative anatomy.

These are not, however, the conditions which prevail in this country at the present time, where on the one hand the average age of graduation from our best colleges is at least two years later than in Germany and France, and on the other hand, the medical schools do not furnish adequate training in physics, general chemistry, and biology, whereas these sciences are now generally included in the curricula of our colleges. When we consider the fundamental importance of these sciences for the study of medicine, the advanced age of graduation from college, and the special conditions of collegiate and medical education in this country, it seems to me clear that during the period of collegiate study the student intending to study medicine should acquire a fair knowledge of chemistry, physics, and general biology, and to these sciences should be added the study of French and German. Inability to read French and

German deprives the physician of personal acquaintance with a large part of the most valuable literature of his profession and makes it impossible for him to keep thoroughly abreast with the progress of medical science and art.

A year's collegiate study, of which practical work in the laboratory should be an important part, is the minimum requirement for such knowledge of physics, chemistry, and biology as should be demanded of medical students upon entrance, and a longer training is desirable. In physics especial attention should be given to mechanical and electric experiments. The student must learn at least the outlines of inorganic chemistry and the elements of organic chemistry, to enable him to study with any degree of intelligence and profit chemic physiology and pathology. In biology he should follow for at least a year a laboratory-course in the structure, life-history, and vital activities of selected types of animal and vegetable life. It is more important that he should acquire certain fundamental concepts concerning the structure and properties of living things, than that he should devote his time to systematic zoölogy. It is impossible to have any adequate understanding of the structure and functions of the human body in health and in disease without a comprehension of the fundamental facts of physics, chemistry, and general biology.

There are certain points which should be clearly understood as regards the requirement that the preliminary education of a medical student should be a liberal one, indicated by a degree in arts or science, and should be made to include a specified amount and kind of knowledge of physics, chemistry, and biology, with a reading knowledge of French and German. The justification for the latter requirement is that, inasmuch as students are kept in college in this country two years longer than in most foreign countries, they should be permitted to pursue during at least the last two years of their course

subjects that bear upon the study of medicine, but which, although included in the medical curriculum in foreign universities, are strictly liberal studies, independently of their professional bearings. These sciences preliminary to medical study can be studied and taught better in the college than in the medical school, and, indeed, in foreign universities they are more often pursued by medical students in the philosophic than in the medical faculty. It would be a waste of energy and money to make provision for them in both the medical and the academic departments.

It cannot be truthfully said that the plan indicated need divert the preliminary education from a liberal to a technical and specialized one, for the degree in arts or science will presumably indicate that the student has a liberal education and the special subjects need not be taken up before the last two years of the course. This scheme presupposes that the student will have made up his mind to study medicine in time to include these special subjects in his undergraduate studies. If he has not done so, or if he chooses to exclude them from his collegiate work, he will be obliged to devote at least a year to them after graduation and before beginning the study of medicine. The college-authorities should, however, direct attention at the proper period of the course to the importance of these subjects for those who intend to study medicine. This plan, moreover, adjusts medical education to existing conditions of collegiate education in this country, without any essential changes in the curriculum of the latter.

The advanced age of graduation from college is a serious embarrassment to higher medical education in this country and has led to the unfortunate result that with the increase in the time required for the study of medicine there has been a falling off in the number of medical students with a college-degree in at least one of our leading medical schools, although it cannot be doubted that the average amount of preliminary education has increased among our medical students.

Various suggestions have been made, especially by the medical faculties of our universities, to remedy this anomalous condition of collegiate education or to adapt it to the needs of medical education. I think that we may assume that the college-course is not likely to be shortened, or that the college will relinquish that part of its development which has made it something between the old college and a university. There is good reason to believe that there are serious defects in our systems of primary and secondary education, and that without lowering the standard of admission better methods of teaching will enable students to enter college at least a year younger than is now the case.

The plan has been adopted in some of our colleges of permitting students to begin their medical studies in the medical department at the beginning of their senior year. This is a plan which, of course, is applicable only when there is a medical school in connection with the college, and involves certain sufficiently apparent difficulties. I think, however, there is much to be said in favor of this arrangement, which permits the student to take up the study of human anatomy, physiology, and physiologic chemistry in his senior year in college, provided he has sufficient preliminary training in the fundamental sciences that have been mentioned. It may, however, be questioned whether the time available for the study of physics, chemistry, and general biology in college is any too long for this purpose, and will permit the addition of human anatomy with dissections, and other subjects that must be a part of the regular medical curriculum. Unless the student has completed the work of one year of the medical course, I do not see the justification of permitting him to shorten by one year the regular medical course because he has a college-degree.

It should be understood that if a medical school requires for admission a year's collegiate training in physics, chemistry, and biology, subjects that are in-

cluded in the medical curricula of European universities, its period of medical study is, according to European standards, lengthened by one year, the first year being relegated to the collegiate period.

The only medical school in this country in which a liberal degree is required for admission is that of the Johns Hopkins University. Here it is also required, for reasons that have been stated, that the candidate for admission shall be able to read French and German, and shall have had a year's collegiate training with laboratory-work in physics, chemistry, and biology. It is of course impossible for unendowed medical schools to demand anything approaching these conditions for admission. I do not undertake to say that, even were other medical schools so situated that they could demand them, it would be wise for them to do so under present conditions, but it seems to me that there is room in this country for at least a few medical schools with such a standard. Exactly what it is feasible to require as a general standard for admission to medical schools in this country at the present time is a subject which, as already said, I do not consider in this address.

It is true that without a liberal education a man may become a competent physician, and may attain even a high standard of excellence in his profession, but with such education he is better adapted for the study of medicine, he is more likely to succeed in his profession, his social position will be better, and his life will be fuller.

The ultimate and essential aim of medical education is to train persons to treat conditions of disease and injury of the living body. This art, the most difficult and responsible of all human arts, rests upon a foundation of scientific facts relating to the structure and functions of the body in health and in disease. These fundamental facts are comprised in anatomy, physiology, and pathology. Upon the basis of these medical sciences the student is prepared to study the nature of therapeutic

agents and their effects upon the body, and to proceed to the study of practical medicine and surgery. The greater part of the time to be devoted to the practical branches must be given to general medicine and surgery, including obstetrics and gynecology, but opportunities must be afforded for acquiring some knowledge of the various specialties. Instruction should be given also in hygiene, legal medicine, and medical history.

To anyone who is at all familiar with the contents, constantly increasing, of these various branches of medical study, it is clear that it is hopeless to attempt to give the medical student a complete knowledge of any one of them. This would require for each subject a period of time at least equal to that available for the study of all.

How long should be the period of undergraduate study in a medical school? In Europe it is nowhere less than four years, and in most European countries it is longer. In Sweden it is nine or ten years, in Spain seven years, in Italy and Holland six years, in Austria, Russia, Portugal, and several universities of Great Britain five years, in Germany four and a half years. In Canada the required period is four years.

According to a statement kindly furnished to me by Dr. John S. Billings, fourteen regular medical schools in the United States either now require, or during the coming year will require, attendance upon four annual courses of lectures in conferring the degree of doctor of medicine. Thirty-seven schools require four years of study, of which one year may be only with a preceptor. Seventy-six require three courses of lectures, and seven require only two courses.

The required period of study in the Medical Department of the Johns Hopkins University, where a full year of collegiate training, with laboratory-work in physics, chemistry, and biology, is required for admission, is, according to European standards, at least five years.

Four years of undergraduate study in a medical

school, each year of study being the usual academic year of about eight months, are as much as can reasonably be demanded in this country at the present time. This length of time is sufficient, if the student enters with a satisfactory preliminary training, especially if, as is often the case, he supplements the undergraduate course with a year or a year and a half in a hospital, or a year of special post-graduate study.

Only those medical schools that have good laboratory and hospital facilities are warranted in establishing a four years' obligatory course. It would be absurd for some medical schools, with their pathetically meager outfit, to require the student to remain with them four years.

As regards the distribution of subjects in the medical curriculum, the amount of time to be given to each, and the methods of teaching, there is, of course, room for much difference of opinion. I should say that in a four years' course the first two years should be devoted mainly to the fundamental medical sciences, to wit: anatomy, physiology, physiologic chemistry, pathology, including bacteriology, and pharmacology, and that the last two years should be given to practical medicine, surgery, obstetrics, and hygiene, with a limited consideration of the more important specialties. Before entering upon the latter half of the course the student should pass an examination upon the studies of the first two years. The examinations upon both the scientific and the more strictly professional subjects should include practical exercises.

The study of human anatomy will extend through the first two years, and will include in the first year dissections and laboratory-courses in normal histology and embryology. Gross anatomy should be taught mainly by dissections and from text-books. Applied anatomy and special dissections will fall mainly in the second year, and partly may be left, as regards special points, to the supervision of the teachers of the practical subjects.

My preference is for the Continental rather than the

English conception of the department of anatomy, viz., that the professor of anatomy should be a scientific man, broadly trained in comparative and human anatomy, not engaged in professional practice, and having under his supervision all that belongs to normal anatomy. He should be well enough paid to be able to give his whole time to his subject, and should have under his charge a well-equipped anatomic laboratory. There is, however, no serious objection to referring the instruction in normal histology and embryology to the physiologic department. Indeed, it is desirable that some consideration of physiologic function should be combined with the instruction in microscopic anatomy.

The subject of physiology, which treats of the normal functions and activities of the body, is of the first importance in medical education. It has attained a higher degree of precision in experimental methods than any other medical science. A good knowledge of physiology is the best corrective to irrational theories and practice in medicine. Physiology has become a highly specialized science, and should be represented in the medical school by a good physiologic laboratory and a teacher who is thoroughly trained in physiologic methods, and can devote his whole time to the subject. It should be taught by demonstrative lectures, text-books, and laboratory-courses. Laboratory-courses in physiology, although important, are hard to arrange, on account of special difficulties inherent in the subject. They do not, therefore, play so predominant a rôle as in the teaching of anatomy and pathology. The study of physiology will continue throughout the first year, and may extend into the second.

The chemic side of physiology has become so large and specialized and is so important in medical education that chemic physiology, or as it is generally called, physiologic chemistry, has come to be recognized as a distinct department in many medical schools. There are advantages in keeping this branch of study in the

physiologic laboratory. Whether or not it is made subordinate to physiology or is established as a separate department will depend largely upon the special interests of the professor of physiology and the kind of man selected to teach physiologic chemistry, as is illustrated by the different arrangements in this regard in the German universities. The teacher should be a thoroughly trained chemist and also familiar with physiology and medicine.

Physiologic chemistry means much more than what is usually taught in our medical schools as medical chemistry, which includes little more than the chemic analysis of certain fluids of the body for diagnostic purposes. Anatomic structure and physiologic function depend to a very large extent upon chemic composition. Our knowledge of the processes of nutrition, digestion, and secretion, both in health and in disease, has been greatly advanced in recent years by the work of physiologic chemists. The microorganisms that cause infectious diseases do injury largely by their chemic products, and many of the questions relating to infection and immunity can be answered only by the aid of chemic investigation.

"I cannot understand," says Hoppe-Seyler, as quoted by Chittenden, "how at the present day a physician can recognize, follow in their course, and suitably treat diseases of the stomach and alimentary tract, of the blood, liver, kidneys, and urinary passages, and the different forms of poisoning, how he can suitably regulate the diet in these and constitutional diseases, without knowledge of the methods of physiological chemistry and of its decisions on questions offering themselves for solution and without practical training in their application."

Physiologic chemistry in the broad sense that I have attempted to indicate should receive proper consideration in a medical school. Its physiologic and pathologic bearings should be emphasized. It should be taught

during the first year largely by laboratory-courses. It is important, as already stated, that the student should enter with sufficient preparation in inorganic and general organic chemistry to enable him to proceed at once to the study of chemistry in its physiologic relations.

Pathology I would place as a principal subject in the second year. This subject embraces general pathology, gross pathologic anatomy, and pathologic histology, and with it can be appropriately associated bacteriology. The student should be taught the proper methods of making post-mortem examinations and of recording the results in protocols. The teaching should be by lectures, text-books, and to a very large extent by demonstrations and laboratory-work. As abundant use as possible should be made of the demonstration of fresh pathologic specimens, which at the same time can be studied in fresh microscopic sections. Bacteriology can be taught in a laboratory-course of two or three months.

It seems to me advantageous that the systematic study of pathology should precede that of the clinical subjects. The latter, however, should be accompanied with the demonstration of pathologic specimens and with courses in clinical microscopy, so that the pathologic knowledge and experience of the student will be kept fresh and will be increased during the last two years of the course. The pathologic laboratory, which it is desirable to have in close connection with the autopsy-room, should be in charge of a professor who gives his whole time to the subject, and it should be well equipped for work in all departments of pathology, including bacteriology. An active and well-organized pathologic laboratory can have a very important influence for good upon the life and scientific activities of a medical school and hospital.

Pharmacology, or the study of the nature of therapeutic agents and their behavior and effects in the living body, has become of late years a more scientific subject by closer association with the methods of physi-

ology, chemistry, and experimental pathology in investigating the action of therapeutic agents upon patients and experimentally upon animals. Our knowledge has become greater and more precise as to the behavior of drugs within the body, and as to their action upon the circulation, digestion, secretion, and other processes and functions of the body. A large number of new drugs are constantly brought to the attention of the profession. Of these Dr. Delafield has said: "Many of the new drugs are of much help to us; we can do useful things to-day that we could not do some years ago, but it must be admitted that we can also do harm in a greater variety of ways." There is a tendency to greater simplicity in prescriptions and a more extensive employment of other than pharmaceutic methods of treatment.

The teacher of pharmacology should be trained in the modern methods of pharmacologic research, and he should have under his charge a laboratory in which the student may acquire by practical work some of this knowledge.

The teaching of the application of therapeutic agents to the treatment of disease should fall to a large extent upon the teachers of clinical subjects.

As the time of the student will be so fully occupied with anatomy, physiology and physiologic chemistry, and the corresponding laboratory-work during the first year, the study of pharmacology may be left to the second year, where it seems appropriately to belong.

When we are told that hygiene is the study of the causes and prevention of disease, and that its aim is to preserve and to promote health, it would seem as if this subject were of the first importance in medical education. But when we consider what a complete department of hygiene really means, and what are the problems with which the modern hygienist has to deal, such questions as the sanitary condition of houses and communities, the contamination and purification of drinking-water, the disposal of sewage, the adulteration of food,

the dangers of certain occupations, the study of vital statistics, matters relating to sanitary legislation, it is apparent that undergraduate instruction in hygiene for the medical student must be more restricted than the theoretic and practical importance of the subject would seem to indicate. Still it is important that some instruction in this subject in the form of demonstrative lectures should be an obligatory part of the course, and among the optional subjects of the last years of the course, laboratory-work in hygiene may be well included. Many licensing and examining medical boards require that the candidate shall be examined in hygiene. The student should learn at least enough of sanitation to know that there are many sanitary subjects upon which intuitional judgments are of no importance, and that as regards these only the opinion of a sanitary expert is of any value.

Practical training in bacteriology falls in many foreign universities to the department of hygiene. This must be taught, but it makes little difference whether it be taught in the pathologic or in the hygienic laboratory, although personally I prefer its association with pathology. Each of these laboratories must be supplied with facilities for bacteriologic work.

We owe to Pettenkofer, of Munich, the first organization of a complete hygienic laboratory, and this has served as the model for many others. The Munich laboratory has been one of the ornaments of the University, and has been of inestimable value to the city in bringing about such great improvements in public sanitation that typhoid fever, the most significant index of the hygienic condition of a city, has virtually disappeared, whereas it was formerly so prevalent that visitors were warned against it. The development of bacteriology and its association with hygiene has led during the last decade to the establishment of a department of hygiene in most German universities. Fortunate that medical school, and especially fortunate that city, in which there is a

well-equipped and active laboratory of hygiene. So beneficent may be the working of such a laboratory to the general community, that this is a department for which the support of the public could be reasonably solicited. Medical officers of public health should of course be especially trained in hygiene, as is required in England.

The last two years of the medical course should be devoted to the study of the strictly professional, the so-called practical, subjects. The previous study of anatomy, physiology, physiologic chemistry, pathology, and pharmacology has been the best preparation for the pursuit of the practical branches of medicine, and it should be recognized that the place of these sciences in the course and the amount of time devoted to them are justified on the ground that they furnish an important part of the training of practitioners of medicine and surgery.

The teaching of the strictly professional subjects must be eminently practical and cannot be satisfactory without sufficient clinical material. The student should have the opportunity of frequently observing patients in the hospital-wards, in the operating-room, and in the dispensary, and of seeing methods of treatment and their results. He should come into personal contact with patients, should examine and study them, should take their histories, follow the course of disease, and report upon the cases. Attendance upon clinical lectures cannot take the place of this direct, personal, continuous observation of cases of disease. Students during their last years should enjoy some of those advantages of a hospital service that have usually in this country been reserved for the fortunate internes. It is especially as regards arrangements for such personal clinical work for the students that our overcrowded medical schools are at a disadvantage as compared with schools of smaller attendance. Hence Billroth, in each of the fifteen editions of his *Lectures on General Surgical Pathology and Therapeutics*, has admonished students :

"Flee therefore in the beginning of your clinical studies the great universities."

The attempt to cover the whole ground of the theory and practice of medicine and of surgery in courses of didactic lectures is rapidly giving place to systematic clinical teaching and recitations from text-books. Practical courses in methods of diagnosis and in the use of clinical instruments of precision are essential. Clinical laboratories have become a valuable adjunct to the department of medicine, and should afford to the student practical courses of instruction relating to such subjects as the examination of sputum, blood, gastric contents, secretions, etc.

Surgical practice has profited even more than medical practice by the scientific discoveries of recent years. The general principles of surgical procedure have become much more simple and straightforward than formerly, and the results of their application are in the highest degree satisfactory. In the allotted time the student can acquire a fair knowledge of these principles by lectures, clinics, and practical courses, but only study and practice after graduation can make him a surgeon.

It seems to me that a considerable part of the instruction on certain subjects in general pathology—as, for example, inflammation and tumors—often assumed by the professor of surgery, should be left to the professor of pathology. I venture to say also that, according to a distinction in titles, and at least to some extent in usage, in many American medical schools the implication that the main professorship of surgery is one primarily of didactic teaching and the subordinate professorships are those of clinical teaching is singularly unfortunate.

Greater use than is customary can be made of experiments upon animals in teaching some matters pertaining to surgery, such as certain details in surgical technique, the healing of wounds of different parts of the body, their behavior under the influence of antiseptics, of foreign bodies, and of other circumstances, etc.

I shall not speak on this occasion of the instruction in obstetrics.

It is impossible for the medical student in his undergraduate days to acquire any thorough knowledge of the various specialties in medicine. Too much should not be attempted in this direction. The study of some specialties should be obligatory, that of others may be optional, but the medical school should furnish opportunities for the study of all.

I should like to see in every medical school a course of lectures upon the history of medicine. It adds to the liberal culture of a physician to learn who have been the great discoverers and the master-minds in medicine, what has been the condition of medicine at different periods of the world's history and among different peoples, what doctrines have prevailed, and by what means progress has been achieved.

As regards the methods of teaching medicine, the keynote at the present time is object-teaching. For nearly two centuries traditions derived from the University of Leyden have largely controlled systems of medical instruction. Purely didactic lectures, designed to cover the whole ground of medicine and surgery, acquired undue prominence in the scheme of instruction. We now believe that greater emphasis should be laid upon the study of text-books, and that the student should be brought into direct, personal contact with the objects of study. The scientific subjects must be taught largely by laboratory-practice and the practical subjects in the clinic.

While laboratory-teaching is of the highest importance, it nevertheless seems to me possible to give to it too exclusive prominence, although I am reluctant to say this in view of the prevalent defects in opportunities for laboratory-work in most of our medical schools. There is no medical school in this country which is able at present to furnish all of the laboratory-instruction which is to be desired.

It should be borne in mind that laboratory-methods are extremely time-taking and are not adapted to teach the whole contents of any of the medical sciences. It is, of course, hopeless to attempt to demonstrate practically all of even the more important facts that the student should learn. Laboratory-work is especially valuable in training methods of thought and observation and in developing the scientific spirit. The knowledge derived from actually seeing, touching, experimenting, is of course more real and impressive than that which comes simply from reading and from listening to lectures, but the student whose knowledge of a subject is derived exclusively from laboratory-courses is likely to lose his perspective in details, to acquire only fragmentary knowledge of a subject, to fail to comprehend the general bearing of observed facts, and not to acquire the general principles and systematic conceptions which are essential. Laboratory-courses may be conducted so that some of these defects are minimized, and these points would perhaps not need emphasis if the time available for the study of the different subjects were unlimited, but a large number of subjects must be taught in a comparatively short time. Laboratory-work should be accompanied and supplemented by the reading of text-books and by lectures. The details of every subject must be learned to a large extent from books. Didactic lectures have their place in presenting the broad outlines of a subject in a systematic way and in emphasizing, as only the living voice can, essential and salient points. Such lectures can be made also demonstrative by drawings, charts, specimens, experiments, the use of the magic lantern and the exhibition of original monographs and works not readily accessible to students.

Recitations upon the subject-matter of lectures, of text-books and of laboratory-courses are especially important. They bring the teacher into personal contact with the student, they secure systematic reading and study, they

bring to light the difficulties and misconceptions of the student, and afford opportunity for their correction.

As I have already said, only a relatively small part of medical science and art can be taught during a period of four years. This necessitates a careful selection of the subjects to be taught, of the amount of time to be given to each subject, of the sequence in which the subjects are to be taken up, and of the methods of teaching. There must be a careful adjustment of the various parts in their relation to the whole, and in their relation to the ultimate objects of medical education—the training of practitioners of medicine and surgery. No subject should be taught as if the student were to become a specialist in it. The teaching must be simple and clear. The problems that are of most interest to the teacher are often not those with which the student need concern himself. The majority of students will not have opportunity or inclination after graduation to devote much time to a continuation of the study of anatomy, physiology, and pathology, and these subjects, being of fundamental importance, should therefore be taught with **much thoroughness.**

It is important that the student should carry away from the medical school a certain mass of positive knowledge. It is still more important that he should acquire some measure of medical wisdom and of the scientific spirit, and that he should have that methodic training in observing and in drawing logical conclusions, and that familiarity with instruments and methods of examination which will enable him to continue independently his education, to follow and incorporate the new discoveries in medicine, and critically to judge and to make the most of his own observations. Medical education is not completed at the medical school; it is there only begun. Of the various subjects in a medical course, the fundamental medical sciences are especially those which afford to the student this methodic training, and are calculated to develop habits of accurate observa-

tion and to stimulate scientific interest in the practical side of his profession. The medical art is becoming more and more the application to practice of medical science. It is the development of medicine along the lines of a biologic science that renders it increasingly attractive to liberally educated men with inclinations to scientific pursuits.

The medical school should afford encouragement to special and advanced work. The few who have the capacity, the inclination, and the time to become investigators and teachers should find there stimulus and opportunity. It should be a place where medicine is not only taught but also studied. It should have a share in the advancement of medical science and art by encouraging original work, and by selecting as its teachers those who have the capacity and the training for such work. The heads of departments should be supplied with a sufficient number of assistants, so that their time need not be given wholly to teaching. These assistants ought to be paid. In most laboratory-courses there should be at least one demonstrator for every fifteen students. In the selection of assistants preference should be given to young men who desire to carry on original work, who have aptitude for such work and for teaching, and who would like to follow an academic career.

The sketch that I have drawn of a medical school is not intended to be an ideal or impracticable one. It is simply what is realized in many foreign universities and what the best opinion in this country desires. It is not to-day realized in any medical school in this country, although a few are approaching this standard.

That a medical school as completely equipped as I have indicated does not exist in this country is not due to any lack of appreciation on the part of medical teachers of its necessity, but is due to the fact that such a school cannot exist without large endowment, either from private philanthropy or from the State, and none

of our schools has sufficient endowment for this purpose.

A properly equipped and organized medical school, with all of the necessary laboratories and a sufficient number of the right kind of teachers, is an enormously expensive affair, far more expensive than any other professional school. The most pressing need of our medical schools to-day is thoroughly equipped laboratories in charge of well-trained teachers and investigators who can give their whole time to their special work. The salary of such a teacher as head of a department ought to be not less than from four to five thousand dollars per annum. There should be six of these laboratories, to wit, of anatomy, physiology, physiologic chemistry, pathology, pharmacology, and hygiene. It is better to place bacteriology with pathology or hygiene than to make of it a separate department.

The suitable construction and equipment of these six laboratories will cost at a moderate estimate from two hundred and fifty to three hundred thousand dollars. From eight to ten thousand dollars is a moderate estimate of the amount needed to cover the average yearly cost of each of these laboratories for salaries of professors, assistants, janitors, and for current expenditures. I should say that, including the fees of students, the interest of not less than \$1,200,000, at 5 per cent., would be required to support a completely equipped medical school in this country. This sum does not, of course, include the amount needed for the support of hospitals connected with the school.

I have been kindly supplied by a friend connected with the Prussian Government with a statement of the amount of money bestowed yearly by the Government upon each of the medical institutes in the different Prussian universities. This amount does not include the salaries of the professors in charge of the institutes, but only the salaries of assistants and servants and the sum available for current expenses. I am permitted to pub-

lish only the total amounts and not the salaries of individuals.

The annual dotation by the Government for each of the following medical institutes in the University of Berlin for the purposes specified is: For the first anatomic institute, 40,690 marks; for the second anatomic institute, 11,430 marks; for the physiologic institute, 47,746 marks; for the pathologic institute, 24,450 marks; for the pharmacologic institute, 17,202 marks; for the hygienic institute, 18,500 marks; for the first chemic institute, 26,440 marks; for the second chemic institute, 18,435 marks. The Prussian Government, therefore, expends annually, outside of the salaries of professors, a little over fifty thousand dollars to support the laboratories of anatomy, physiology, pathology, pharmacology, hygiene, and chemistry in a single university. About three times as much money is given by the Government to the support of the laboratories as is devoted to the salaries of the professors, but these salaries are largely, often many times, increased by the fees of students. In Germany the expenses of living and of the purchase of laboratory-supplies are less than in this country.

Medical education in this country has until recently been left to its own devices. Only within recent years has it received any aid worth speaking of from private philanthropy or the State, save the indirect aid from the establishment of hospitals and dispensaries.

The greatest impulse for the endowment of higher education in this country has been religious zeal. Contrast for a moment the endowment of theologic study with that of medical study. According to the forthcoming *Report of the Bureau of Education*, for proof-sheets of which I am indebted to the kindness of Mr. Harris, the Commissioner of Education, there were in the United States in 1890-91 only five endowed chairs in medical colleges, and not a single one of these south or west of Philadelphia. It may, I think, be questioned whether all or even any of the five chairs were adequately en-

dowed. On the other hand, there were 171 endowed chairs of theology, many of these being in the West and South. According to the report of the same bureau, as quoted by Dr. Bayard Holmes, the productive funds in the hands of medical schools, both those connected with and those independent of universities, in the United States was, in 1889, \$249,200; while, at the same time, there were in the hands of schools of theology productive funds to the amount of \$11,939,631. In 1892, these figures were, for medical schools, \$611,214, and for theologic schools, \$17,599,979. In 1890-91, out of a total of \$1,466,399 given to institutions for professional instruction, 63 per cent. was given to theologic schools and 17 per cent. to medical schools. Medical departments of State universities received, in 1892, State aid amounting to \$40,500; technologic schools received State aid to the amount of \$747,504. When one considers that there are more than twice as many students of medicine as of theology, and that medical instruction is much more expensive than that of theology, and requires costly laboratories, the contrasts afforded by these figures are startling.

The Report of the Commissioner of Education comments as follows upon these statistics and similar ones relating to legal education: "There can be no doubt of the propriety of private philanthropy endowing theological study, nor of the State's enterprise in supporting technical and pedagogical studies, but it is difficult to discover why such consummately practical and important topics as law and medicine should be neglected by private benevolence or public caution. It seems to be conceded that unendowed instruction in law or medicine will be just as poorly given as unendowed instruction in theology or pedagogy. Yet we find instructors in both these sciences, though necessarily State-supported on the Continent of Europe, in America left to live upon the meager diet of tuition-fees."

Higher medical education, no more than any other

form of higher education, is self-supporting. A number of reasons might be specified to explain this singular neglect of medical education as an object of private endowment or State aid. I shall not consider these reasons here. Many of them pertain to conditions that have changed or are changing. The tide has already turned, and "the old order changeth, yielding place to new." The doom of the medical college responsible to nobody, without hospital or laboratory facilities, has sounded.

"Unto every one that hath shall be given, and from him that hath not shall be taken away even that which he hath."

The needs of medical education have begun to be recognized by high-minded and public-spirited philanthropists, such as Johns Hopkins, Vanderbilt, Mary Garrett, and your own John L. Woods. Such benefactors have "linked their names to those imperishable things" which make the most enduring monuments of a republic. I was particularly impressed by Mr. Adams' statement in his memorial address upon John L. Woods in this place, last October, that Mr. Woods' generous benefaction to this college was chiefly determined by "the fact that medical education had never been a favorite object of benevolence, while the improvement of medical education was really of the greatest importance."

In conclusion, let us not forget that a university or a medical college may have large endowments, palatial buildings, modern laboratories, and still the breath of life not be in it. The vitalizing principle is in the men—both teachers and students—who work within its walls. Without this element of life, this bond between teacher and taught, these things are but outward pomp and show. But let these greater opportunities receive the breath of life from the inspiration of great teachers and they then become the mighty instruments of higher education and scientific progress.

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